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FIG. 1

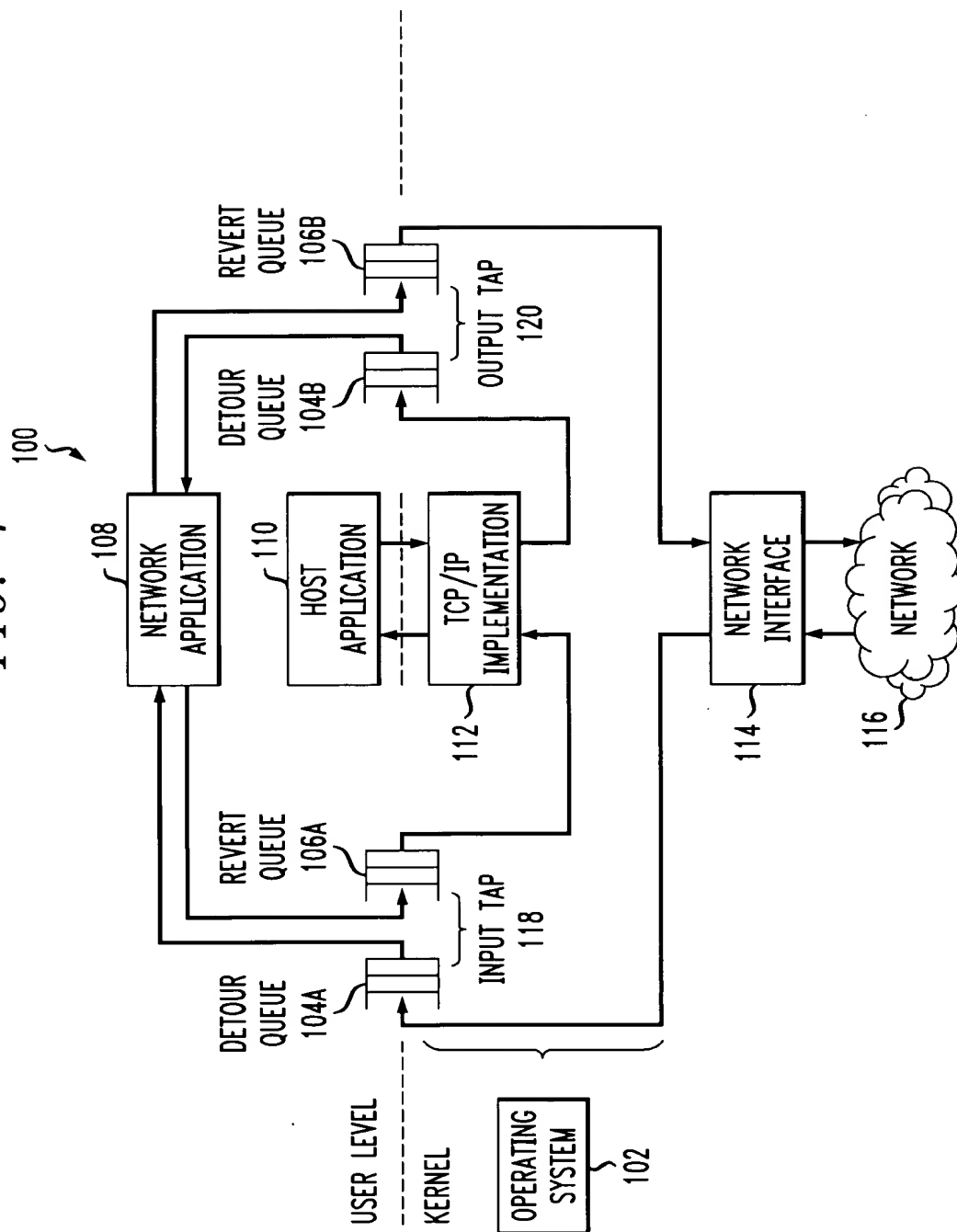


FIG. 2

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```

200 {
202 {
    #define CQ_LENGTH 268 /* Power of 2 */
    struct cq {
        int head;
        int tail;
        void *(*cqa)[CQ_LENGTH];
    };

    static __inline int cq_enqueue(struct cq *cqp, void *p) {
        int t, nt;
        if (cqp->head ==
            (nt = (((t = cqp->tail) + 1) & (CQ_LENGTH - 1)))) {
            return 0; /* Queue is full */
        } else {
            (*cqp->cqa)[t] = p;
            cqp->tail = nt;
            return 1;
        }
    }

    static __inline void *cq_dequeue(struct cq *cqp) {
        int h;
        void *p;

        if ((h = cqp->head) == cqp->tail) {
            return 0; /* Queue is empty */
        } else {
            p = (*cqp->cqa)[h];
            cqp->head = ((h + 1) & (CQ_LENGTH - 1));
            return p;
        }
    }

    extern int mbuf_map(struct cq **mbuf_alloc,
                       struct cq **mbuf_dealloc, int mbuf_prealloc);

    extern int mbuf_unmap();

    extern int mbuf_pull(int nbufs, int timeout);

    extern int mbuf_push(int tap_descriptor, int nbufs);

    extern int interface_tap(char *ifname,
                            struct cq **detour, struct cq **revert, int mode);

    extern int interface_untap(int tap_descriptor);

```

FIG. 3

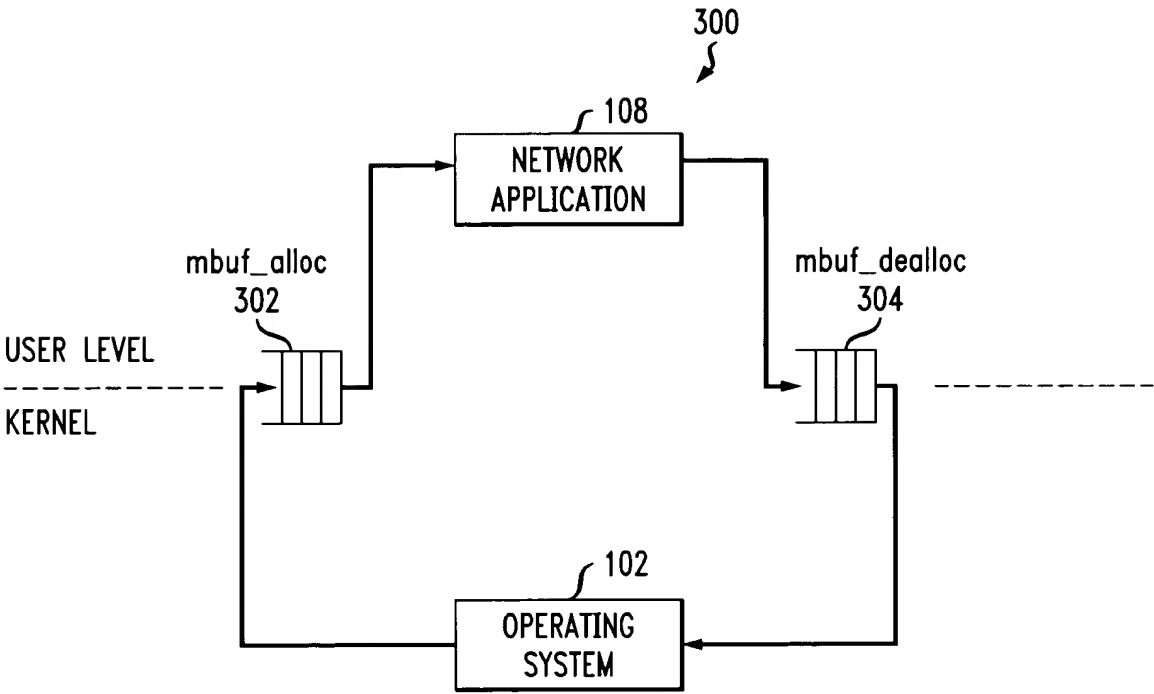


FIG. 4

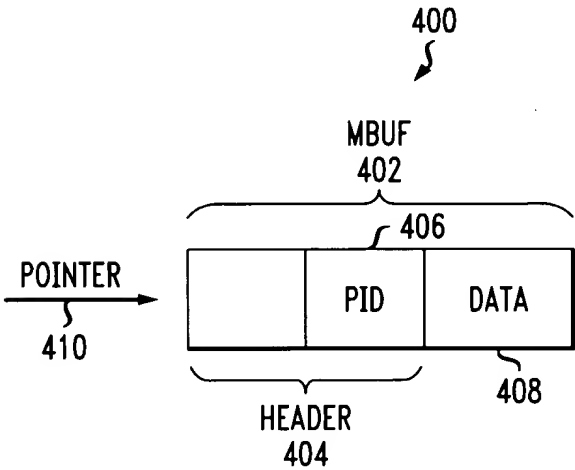
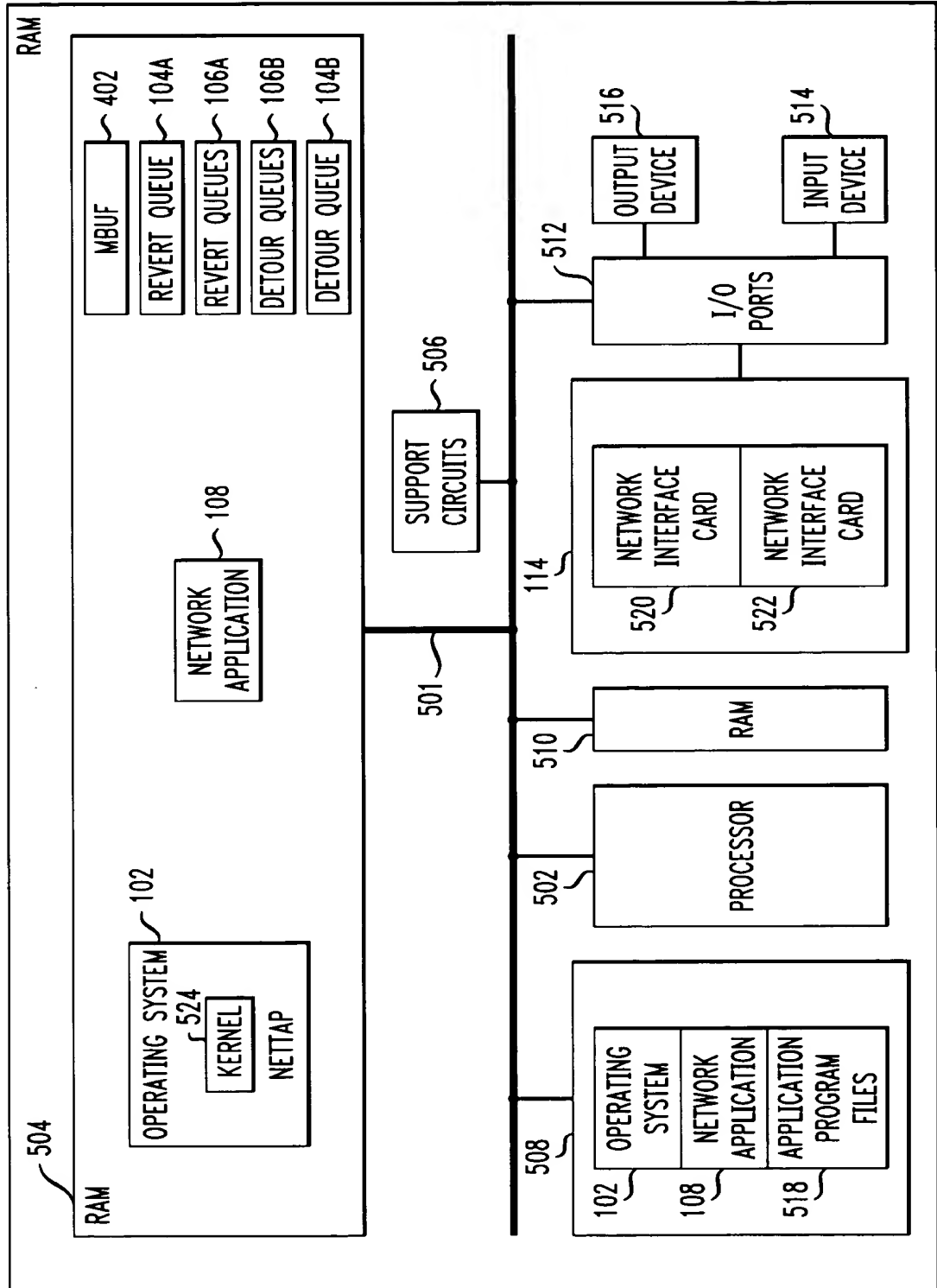


FIG. 5

500



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FIG. 6

600

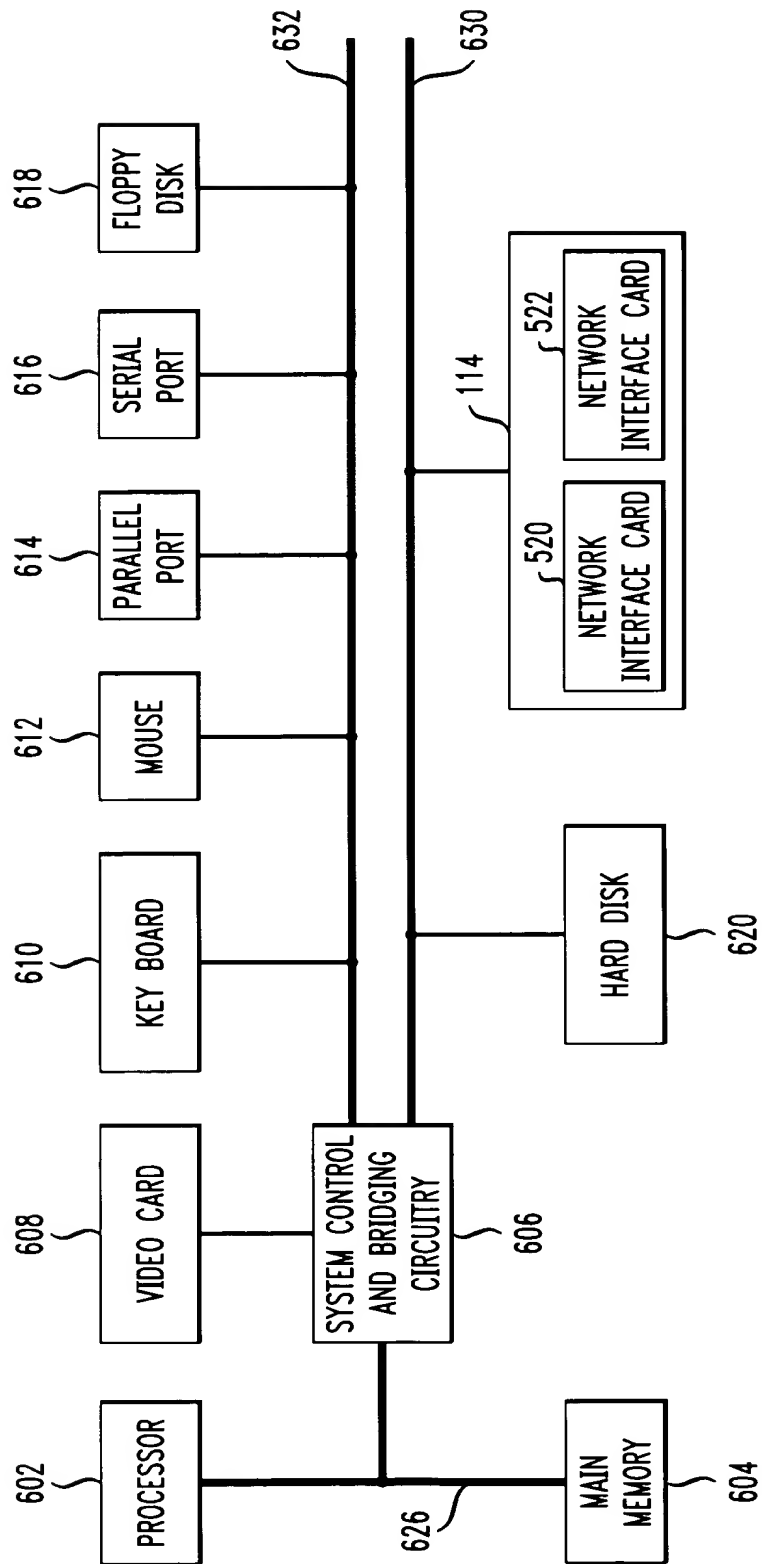


FIG. 7

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FIG. 7A

FIG. 7B

FIG. 7A

```

#define ERROR(msg) {perror(msg); exit (1);}

#define BUSY_WAIT_LIMIT 10

#define CLASS_DENY 0
#define CLASS_ACCEPT 1
#define CLASS_HOST -1

int network_application(struct mbuf *m) {
... process packet and return its classification...
}

void drop(struct cq *dealloc, struct mbuf *m) {
    if (cq_enqueue(dealloc, m) == 0) {
        mbuf_push(-1, 0);
        if (cq_enqueue(dealloc, m) == 0) {
            ERROR("Deallocating");
        }
    }
}

main () {
    int i, class, out, nempty, tin[2], tout[2];
    struct cq *alloc, *dealloc, *detour_r[2],
        *revert_ip_in[2], *detour_ip_out[2], *revert_t[2];
    char name[] = "fxp0";
    struct mbuf *m;

                                /* Map mbufs */
    if (mbuf_map(*alloc, *dealloc, 0) != 0) {
        ERROR("Mapping mbufs");
    }
    for (i = 0; i < 2; i++) { /* Tap interfaces */
        name[3] = (i == 0) ? '0' : '1';
        if ((sin[i] = interface_tap(name, *detour_rx[i],
                                *revert_ip_in[i], TAP_INPUT)) < 0) {
            ERROR("Tapping input");
        }
    }
}

```

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FIG. 7B

```

}
if ((tout[i] = interface_tap(name, *detour_ip_out[i],
    *revert_tx[i], TAP_OUTPUT)) < 0) {
    PERROR("Tapping output")
}
}
for (nempty = 0, i = 0; ; nempty++, i = (i + 1) * 1) {
    if ((m = cq_dequeue(detour_rx[r])) != 0) { /* Rr pkt */
        nempty = 0;
        if ((class = network_application(m)) ==
            CLASS_ACCEPT) { /* Bridge pkt */
            out = cq_enqueue(revert_tx[(i + 1) & 1], m);
        } else if (class == CLASS_HOST) { /* Host input */
            out = cq_enqueue(revert_ip_in[i], m);
        } else {
            out = 0;
        }
        if (!out) { /* Drop if queue full or pkt denied */
            drop(dealloc, m);
        }
    }
}
if ((m = cq_dequeue(detour_ip_out[1])) != 0) {
    nempty = 0; /* Host output */
    if (cq_enqueue(revert_tx[i], m) == 0) { /* Tx pkt */
        drop(dealloc, m); /* Drop if queue full */
    }
}
if (nempty == BUSY_WAIT_LIMIT) {
    mbuf_pull(0, 0); /* Wait for pkt */
    nempty = 0;
}
}
}

```